

Interactive environment familiarization and indicator trainer

User evaluation

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DRDC - Toronto Research Centre

Defence Research and Development Canada

Scientific Report

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IMPORTANT INFORMATIVE STATEMENTS

This work was conducted under the Counter Improvised Explosive Device Technology Demonstration Program: Awareness Training Project (12RR03) sponsored by the Canadian Forces Counter Improvised Explosive Device Task Force.

The data collected as part of this study was approved either by Defence Research and Development Canada's Human Research Ethics Board or by the Director General Military Personnel Research & Analysis' Social Science Research Review Board.

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Abstract

Defence Research and Development Canada Toronto Research Centre is developing the Environment Familiarization and Indicator Trainer (EFIT) as part of the Improvised Explosive Device (IED) Awareness Training Project of the Counter Improvised Explosive Device Technology Demonstration Program. EFIT is a training tool that provides instruction on IED combat indicators and what to look for in a given area of operation.

A user evaluation was conducted with a prototype of Interactive EFIT software with seven members of the Peace Support Training Centre in Kingston Ontario. The intent of the evaluation was to determine the usability of Interactive EFIT and to gain user feedback on EFIT's training potential.

Participants were briefed on how to use the software and they were asked to perform four tasks using the think-aloud technique. Observations were made as to how participants interacted with the software. Participants also completed a usability questionnaire, rated the usefulness of Interactive EFIT for seven learning objectives and rated the usefulness of proposed features.

Overall, participants evaluated the Interactive EFIT positively and found it to have potential as a training tool. Improvements should be made to Interactive EFIT to make the software more flexible, stimulating and intuitive.

Significance to defence and security

IEDs posed a significant threat to the safety of Canadian Armed Forces personnel in Afghanistan and may pose threats in future combat missions. Participants in this study evaluated Interactive EFIT positively and found it to have potential to train the detection of IED combat indicators and found it useful for route and theatre-specific terrain familiarization. Interactive EFIT can be valuable for Theatre Mission Specific Training trainers briefing IED threats. Soldiers could also benefit from using Interactive EFIT on their own to explore routes within their area of operations and become familiar with local threats.

Résumé

Le Centre de recherche de Recherche et développement pour la défense Canada – Toronto travaille à la mise au point d'un simulateur d'indices et de familiarisation avec l'environnement (EFIT) dans le cadre du projet de sensibilisation aux dispositifs explosifs de circonstance (IED) du Programme de démonstration de la technologie pour contrer les dispositifs explosifs de circonstance. L'EFIT est un outil offrant une formation sur les indices de combat avec IED et expliquant ce qu'il faut tenter de repérer dans une zone d'opérations donnée.

Sept membres du Centre de formation pour le soutien de la paix de Kingston (Ontario) ont évalué un prototype du logiciel interactif EFIT. Cette évaluation par des utilisateurs visait à déterminer la convivialité du logiciel et à obtenir des commentaires sur son potentiel comme outil de formation.

Les participants ont été informés sur la façon d'utiliser le logiciel et ont été invités à accomplir quatre tâches au moyen de la technique de réflexion à haute voix. On a ainsi pu observer comment les participants utilisaient le logiciel. Ceux-ci ont également rempli un questionnaire sur la convivialité, évalué l'utilité de l'EFIT interactif relativement à sept objectifs d'apprentissage et évalué l'utilité des fonctionnalités proposées.

Dans l'ensemble, les participants ont fait une évaluation positive du simulateur interactif et estiment qu'il pourrait constituer un bon outil de formation. Des améliorations devraient être apportées pour créer un logiciel plus souple, plus stimulant et plus intuitif.

Importance pour la défense et la sécurité

Les IED ont représenté une menace importante pour la sécurité du personnel des Forces armées canadiennes en Afghanistan et sont susceptibles de constituer une menace lors de futures missions de combat. Les participants à cette étude ont fait une évaluation positive de l'EFIT interactif et estiment qu'il pourrait servir d'outil de formation à la détection d'indices d'IED en situation de combat; ils le trouvent utile pour se familiariser aux routes et à l'environnement propre à un théâtre. Le simulateur interactif pourrait être utile aux instructeurs offrant l'instruction axée sur le théâtre et sur la mission (IATM) pour exposer les menaces liées aux IED. Les soldats pourraient également tirer profit de l'EFIT en l'utilisant pour étudier les routes dans leur zone d'opérations et se familiariser avec les menaces locales.

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1 Introduction

1.1 Background

Improvised Explosive Devices (IEDs) posed a significant threat to the safety of Canadian Armed Forces (CAF) personnel deployed in Afghanistan combat missions. In 2008 the Chief of Defence Staff stated that “[IEDs] remain the single most dangerous weapon employed by insurgents in Afghanistan, accounting for the majority of Canadian combat related casualties” (Chief of Defence Staff, 2008). Despite Canada’s withdrawal from combat operations in Afghanistan it is anticipated that soldiers will continue to face the threat of IEDs in future missions. Research and development efforts continue throughout Defence Research and Development Canada (DRDC) and the CAF to mitigate IED casualties.

Many counter-IED efforts focus on developing new technologies to detect, avoid, neutralize or protect personnel from IEDs. However, despite technological advances, detecting IEDs still depends very much on the judgment and unaided perceptual skills of soldiers (Zorpette, 2008). Accordingly, the CAF Counter-IED Tactics, Techniques and Procedures (TTPs) handbook (Department of National Defence, 2006) directs personnel to monitor their environment for the presence of a number of perceptual cues (“combat indicators”) that suggest an elevated probability of the presence of IEDs. These indicators, such as, abnormal pattern of life, freshly dug holes, new asphalt patches, canalizing terrain, IED components (fuse and firing mechanism, detonator, explosive, casing, detonator power source), altered vehicles, etc. and the task of searching for them are typically taught during pre-deployment Theatre Mission Specific Training (TMST) through PowerPoint theory lessons, “petting zoos” of reproduced or actual IEDs retrieved from theatre, and walk-throughs of IED lanes.

The IED Awareness Training Project at DRDC Toronto, part of the Counter Improvised Explosive Device Technology Demonstration Program (Counter-IED TDP) looked at ways of improving training of IED combat indicators. Keillor, Jarmasz, Pavlovic and Lamb (2007) showed that troops with Afghanistan road travel experience scan for threats in video from a moving vehicle on Afghanistan roads differently than civilians who hadn’t been to Afghanistan. This suggests that there are trainable skills for visually scanning real scenery that may improve IED detection.

To improve the training of visual scanning for IEDs we developed various prototypes of the Environment Familiarization and Indicator Trainer (EFIT). EFIT combined real video of convoy operations with a map of high resolution satellite imagery and vector data (roads, culverts, locations of past IED incidents, and other terrain features). The videos were accompanied by subject matter expert (SME) commentary and visual overlays to direct the attention of the viewers to IED combat indicators. In an interactive prototype of EFIT users could pan and zoom on the map, launch moving vehicle videos, and obtain more information about previous IED incidents.

1.2 Study objective

The primary objective of this study was to determine how usable EFIT was for soldiers required to learn about the Afghanistan environment and IED combat indicators. By

usable it is generally meant that software is “easy to learn, effective to use, and provide an enjoyable user experience” (Preece et al., 2002).

The secondary objective of this study was to gain user feedback on EFIT’s training potential¹. EFIT designers expected EFIT to reduce the amount of time in theatre becoming familiar with commonly travelled routes and the cultural and natural environment of the CAF area of operations (AO). Troops interviewed by Keillor et al. (2007) reported developing an intuitive sense for situations of high threat or those with a high potential for IEDs after a few months into their first rotation in theatre. Often this “spidey sense” or pattern knowledge was difficult to verbalize into a clear set of rules or cues. EFIT designers expected that through “training the background”, or training what the normal day-to-day Afghanistan environment (or other theatres of operation) looks like through watching video from a moving vehicle alongside a dynamic map, EFIT could help improve troops’ ability to recognize abnormal situations. EFIT designers anticipated that by passing knowledge and lessons learned from previous rotations, EFIT would provide familiarization of common IED threat types, introduce common IED combat indicators by threat type in visual context, and train possible Counter-IED actions to mitigate threat. This study sought SME feedback on whether EFIT could be a useful training tool in this regard.

The results of this study will inform future EFIT design decisions ensuring the end product meets the needs of its CAF users.

1.3 EFIT development

1.3.1 Early prototypes

The first prototype of the EFIT concept was developed in February 2007. It consisted of a one minute video clip from a ground vehicle in Afghanistan alongside an aerial photo with a moving track showing the position of the video camera. A screenshot of the video is shown in Annex A Figure A.1. The concept was further developed with a second video prototype shown in Annex A Figure A.2 that built on the original idea, but added overlays onto the video that could be used to point out IED combat indicators or points of interest. The map portion of the video was also augmented to increase the visibility of the track of the camera, show points of interest within the environment, and demonstrate how future versions of the concept could have an interactive map (panning and zooming).

1.3.2 Non-Interactive EFIT

Two further prototypes of EFIT (non-interactive EFIT) were completed in January 2008. SMEs, mostly Combat Engineers with Afghanistan deployment experience from a local Reserve unit, reviewed video footage of Kandahar province and noted IED combat indicators. Multiple SMEs reviewed each segment of video. SME comments were pooled and reviewed for how often they identified the same IED combat indicators. Clips were selected based on the diversity of terrain,

¹ A scientific training effectiveness assessment of more recent versions of EFIT can be found in Zotov et al. (2014). Zotov et al. showed participants can improve their IED threat assessment skills by watching EFIT videos.

built environment, and the quantity of multiply identified IED combat indicators. An approximately 1.5 minute rural clip between Kandahar Airfield (KAF) and Kandahar City (Figure 1) and an approximately two minute urban clip within Kandahar City (Figure 2) were selected. A script for each video was written using the SME notes. The scripts pointed out IED combat indicators, points of interest, and possible tactical actions. The scripts were read, recorded, and added as audio tracks to the non-interactive EFIT prototypes. On the right side of each video was an image from 70 cm resolution imagery (one pixel for every 70 cm in the real world). A red line indicated the route the ground vehicle traveled.



Figure 1: Screenshot of rural non-interactive EFIT prototype between Kandahar Airfield and Kandahar City.



Figure 2: Screenshot of urban non-interactive EFIT prototype within Kandahar City.

Throughout the development of EFIT the various prototypes underwent a series of usability evaluations consistent with the principles of interaction design. Interaction design is a discipline which provides guidelines on how to optimally design software interfaces to suit the environment in which they are to operate. Interaction design dictates that “identifying usability and user experience goals is essential for making every product successful” (Preece et al., 2002) and that

an understanding of users' needs should be reflected in the design of the software (Preece et al., 2002).

The 2nd Combat Engineer Regiment (2CER), in Petawawa, used the two non-interactive EFIT prototypes as part of Explosive Threat and Hazard Awareness and Recognition (ETHAR) lectures during TMST for Task Force (TF) 3-08 (Operation Athena Rotation 6). 1CER used the two non-interactive prototypes as part of TF 3-09 (Operation Athena Rotation 8) training.

Eleven training instructors and 81 students (32 from TF 3-08 and 49 from TF 3-09) provided feedback on the prototypes by completing a brief Usefulness Questionnaire (Annex C.7). Full Usefulness Questionnaire results are presented in Section 3.2.1, but one of the key results from the non-interactive EFIT TF 3-08 testing was that instructors felt EFIT could be improved as an instructional tool by making the map interactive. Instructors felt an interactive map with zoom would be useful to demonstrate map reconnaissance (recce) prior to watching the video.

1.3.3 Interactive EFIT

A paper prototype (non-functional PowerPoint interface sketch) for an interactive version of EFIT (Figure A.3) was drafted in mid-2008. Contained within a standard Windows graphical user interface the prototype illustrated an interactive map with panning and zooming, symbols representing past IED incidents, options for switching background imagery (satellite, map, etc.), the ability to right-click and select from multiple videos of the same route taken on different dates/times of day, position in vehicle, or type of sensor. There were also controls for video playback, visual overlays of IED combat indicators, and soundtrack options for selecting between SME commentary, real radio communications (Comms), etc.

The paper prototype was partially implemented as an add-on to ArcGIS 9.2 (Esri, Redlands, California), a commercial mapping and data analysis software using Visual Basic for Applications (Microsoft Corporation, Redmond, Washington). A screenshot of the Interactive EFIT prototype evaluated in this study is shown in Figure 3. Interactive EFIT consisted of four main interface components: 1. interactive map, 2. route video panel, 3. options panel, and 4. EFIT toolbar. The interactive map shown in Figure 4 could be used to view roads, past IED incidents and select route video tracks to watch. Roads were shown on the map using green lines, past IED incidents were shown with diamond symbols and labelled with the type of IED. The route video tracks were shown by thick blue lines augmented with arrows to show the video's forward direction. Tracks could be clicked to play video of the track at the location clicked (the tracks were made up of a series of selectable line segments although they appeared continuous to users). The route video panel allowed users to play, stop, pause and fast forward through the route video tracks.



Figure 3: Screenshot of the interactive EFIT prototype used in this study. Note the four main interface components: 1. options panel, 2. route video panel, 3. interactive map, and 4. EFIT toolbar.

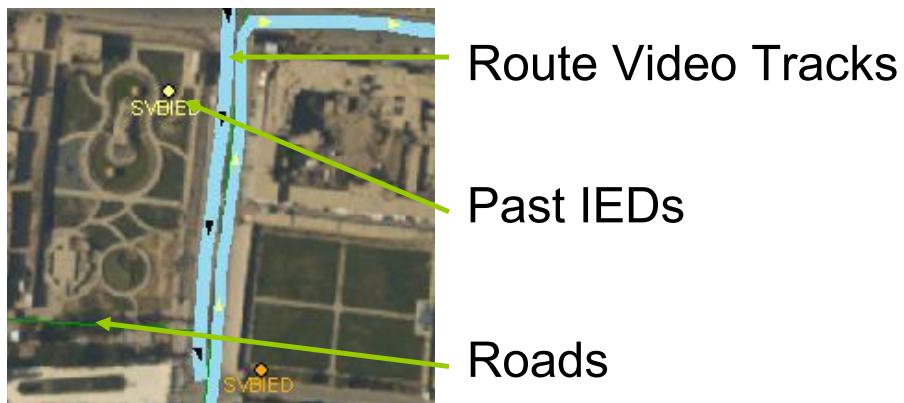


Figure 4: Close-up of interactive map.

The options panel listed all of the route video tracks that are loaded into Interactive EFIT. To play a video, users clicked on the name of the route and clicked the play icon on the route video panel. The options panel also had options to select whether you want to play a familiarization video of the route video or an indicator training video. The familiarization video was an unedited video whereas the indicator training video had expert commentary about the route and highlighted potential IED combat indicators. The tools required to operate Interactive EFIT were located on the EFIT toolbar shown in Figure 5.

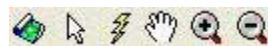


Figure 5: EFIT toolbar.

Where:

-  Opened the Interactive EFIT program.
-  Allowed users to select and click on the map. While watching a video users could click on part of the track to jump to that location in the video.
-  Allowed users to open incident reports linked to a particular IED strike. An IED strike location turned blue when rolled over with the mouse.
-  Allowed users to pan the map. Clicking and holding with the middle mouse button panned the map.
-  Allowed users to zoom in on the map. The middle scroll wheel could also be used.
-  Allowed users to zoom out on the map. The middle scroll wheel could also be used.

In order to evaluate whether Interactive EFIT supported user needs and, thus, was suitable for eventual integration in pre-deployment training, user testing of the software was required. This report documents the user testing of Interactive EFIT with SMEs at the Peace Support Training Centre.

2 Methods

2.1 Study overview

This study was designed to evaluate the usability of Interactive EFIT by having CAF personnel perform four tasks with the system. The tasks were based on previous discussions with SMEs as to what TMST students and instructors might typically do when the final version of EFIT is delivered. We recorded participants' interactions with the prototype as they completed the tasks. Participants were encouraged to speak aloud, describe what they were doing and what they expected of the prototype as they completed their tasks. These comments were recorded along with the rates of feature use and "errors" (situations where the designers' expectations of how users would use Interactive EFIT did not correlate with the participant's actions). Following completion of the tasks, participants completed a usability questionnaire and a usefulness questionnaire. The remainder of this chapter provides further details of these methods.

2.2 Participants

Seven male participants were recruited from the Peace Support Training Centre (PSTC) at Canadian Forces Base (CFB) Kingston March 10-12 2009. All participants met the standard personnel requirements for the CAF (active duty age range 18 to 60) with standard vision and health. Years of service ranged from 12 to 25 years. A Major, Captain, Master Warrant Officer, two Warrant Officers and two Sergeants participated. Participants had attended Mine Awareness Training (MAT) or ETHAR between three and over 20 times in their careers. All but one participant had deployment experience in Afghanistan. Participants were not remunerated for their participation as no abnormal stress or discomfort was anticipated (DAOD 5061-1, 1998).

2.3 Room set-up

The user evaluations took place over three days, March 10-12, 2009 in a meeting room at CFB Kingston. Interactive EFIT was setup in the centre of the table on a computer with an 18 inches liquid crystal display monitor (see Figure 6). A laptop was placed to the right of the main computer with a QuickCam pro for Notebooks (Logitech, Silicon Valley, California) webcam to record the participant sessions. Participants sat in a chair approximately 60cm in front of the Interactive EFIT computer. Data recorders sat on either side of the participant (Figure 7). Participants were free to adjust the chair to a comfortable seating position.



Figure 6: User evaluation room set-up. Interactive EFIT computer in center with video recording laptop on right.

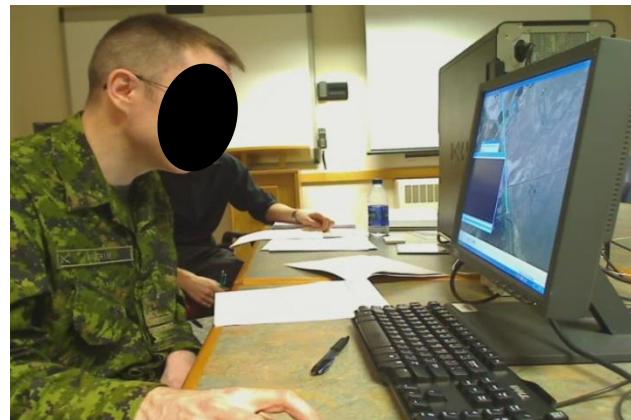


Figure 7: A participant using Interactive EFIT. Note how this participant has maximized the map to fill the whole screen.

2.4 Interactive EFIT set-up

The Interactive EFIT prototype was loaded with three route videos, each with an in-vehicle audio track and two with expert commentary and visual overlays. The first video was a one minute, 35 second long route between KAF and Kandahar City (Figure 8a). The expert commentary

describing potential aiming markers, culvert concealment, canalized situations and civilian behaviour can be found in Annex B.1. Items described in the audio commentary were highlighted with black circle outlines.

The second video was a two minute, 20 second long route within Kandahar City departing from the Governor's Compound (Figure 8b). The expert commentary describing chokepoints, civilian behaviour, suicide vehicle-borne IEDs and firing points can be found in Annex B.2. The commentary version of this video also had black circle outlines. The third video was a 14 minute, 38 second long route from Ma'Sum Ghar (MSG) to Patrol Base Sperwan Ghar (PBSG) (Figure 8c). The third video had an audio track of voice actors simulating the communications between a crew commander, driver, gunner and convoy commander. The Comms script (Annex B.3) was derived from observations SMEs had made when reviewing the video. The Comms also contained informal chatter between vehicle members.



Figure 8: Screen shots from the three trial videos: (a) paved rural, (b) paved urban, (c) dirt rural.

2.5 Procedure

Participants were greeted and asked to read the information sheet (Annex C.3) and consent form (Annex C.4). They were given a chance to ask any questions pertaining to the study before signing the consent form if they wished to participate. Participants were then given an evaluation package containing a description of Interactive EFIT, its interface components, the tasks they would be asked to perform (Annex C.5), a Usability Questionnaire derived from the work of Chin et al. (1988, Annex C.6), and a Usefulness Questionnaire (Annex C.7). The usability items focused on the participants' interaction experience with the software interface whereas the usefulness items asked participants about new features and how effective the software was as a trainer. As participants worked through the evaluation package they were asked if they had any questions to ensure they understood the experimental protocol.

Interface images and text descriptions in the Interactive EFIT 101 section of the evaluation package (Annex C.5) were used to introduce participants to the map symbology for the route video tracks, IEDs and roads. The evaluation package informed participants that clicking on the map tracks plays video tracks. The evaluation package described: 1) the route video panel where participants could stop, pause, play or fast forward through the route video tracks, 2) the options panel where participants play route videos with and without expert commentary, and 3) the EFIT toolbar with the tools to open the Interactive EFIT program, select a video on the map, open IED incident reports, pan the map, and zoom in and out on the map.

Once participants felt they were comfortable with the Interactive EFIT interface components they read the instructions for the first task and began using Interactive EFIT. The four tasks were potential use cases for Interactive EFIT and were created to encourage participants to use the various features of the Interactive EFIT prototype. The instructions given for each task are as follows:

1. You will be deployed to Afghanistan in several months and have received EFIT as part of your pre-deployment training package. You know that you will be travelling between Kandahar Air Field (KAF) and Kandahar City frequently. To prepare for your tour, take some time to get used to what the route looks like. It is expected that you will be in the gunner position for the majority of your tour.
2. The IED threat in Afghanistan is currently high. To prepare yourself for this high level of threat, learn about potential IED indicators on the route between KAF and Kandahar City.
3. You are about to go on your first convoy mission through Kandahar City and you want to learn more about the types of IED indicators that typically occur in an urban environment. Your crew commander tells you that canalizing from vehicles [sic] is something that you will need to prepare for. List below examples of canalization on the route through Kandahar City.
4. You have been tasked to be an air sentry on a convoy travelling between MSG and PBSB [sic] and you want to be aware of possible IED threats on that route. Find out what the most common type of IED used on this route was for 2008. List below the key messages from the crew commander in the instructional video.

While the participants completed these tasks they were asked to follow the “think-aloud” protocol. Participants were encouraged to describe their actions, intentions, frustrations and appreciations as they used the software. We took written notes of the participant’s comments and actions in addition to video recording the sessions.

Upon completing the four tasks participants were asked to fill out the 27 item Questionnaire for User Interface Satisfaction (QUIS) (Chin et al. 1988, Annex C.6), henceforth referred to as the usability questionnaire. The usability questionnaire gauged the participant’s overall reaction to the software, screen attributes, terminology and system information, learning, system capabilities, the three most negative aspects of the software and the three most positive aspects. Participants were also asked to fill out a Usefulness Questionnaire (Annex C.7) regarding their background with the CAF, to rate the usefulness of 15 proposed additions/improvements to Interactive EFIT, and rate the usefulness of Interactive EFIT for learning seven of the key EFIT learning objectives (e.g., becoming familiar with routes, finding IED indicators, etc.). Participants were also asked what they thought they learned from Interactive EFIT and to provide any additional comments. The entire evaluation took one to two hours to complete.

2.6 Measures

2.6.1 Usability

Qualitative feedback was the primary measure to evaluate the usability of Interactive EFIT. Participants' verbal comments were noted as well as the difficulties we observed as participants attempted to complete the four tasks. Participants' feedback on the QUIS Usability Questionnaire as to the three most negative aspects of the software and the three most positive aspects also provided an indication of how the software could be improved.

The QUIS Usability Questionnaire also provided quantitative measures of the usability of Interactive EFIT. The QUIS Usability Questionnaire had 27 ratings with a 10 point Likert scale from zero to nine from left to right. Each rating was anchored at both endpoints with adjectives (e.g., inconsistent/consistent). Negative adjectives were always positioned on the left (0) and positive adjectives were positioned on the right (9). Participants also had the option to select Not Applicable (NA) for each rating. In a previous study by Chin et al. (1988) users on average rated software products they liked higher than ones they disliked for all 27 ratings.

The seven participants' usability questionnaire data were averaged. Those questions with the highest ratings indicate areas where the software is on the right track, while lower scores indicate areas where the software can be improved. We considered ratings from zero to four to be negative feedback and ratings five or above as positive feedback.

We also recorded whether participants used software features. Low rates of feature use across participants indicate that a feature may be difficult to use, or require further training.

2.6.2 EFIT's training potential

The primary mechanism to gauge Interactive EFIT's training potential was the Usefulness Questionnaire. The Usefulness Questionnaire had five questions. The first question asked participants about their military service experience. The second question asked participants to rate the usefulness of 15 proposed additions/improvements to Interactive EFIT on a scale from one (not at all useful) to five (extremely useful). The third question asked participants to rate the usefulness of Interactive EFIT to learn seven specific skills on a scale from one (not at all useful) to five (extremely useful). The fourth question asked participants if they learned anything new while observing Interactive EFIT that was not included in the training they had previously received. And the fifth question asked participants to provide any additional comments.

We also captured verbal comments on how Interactive EFIT could be used beyond its envisioned use by ETHAR trainers briefing TMST IED threats.

3 Results and discussion

3.1 Usability

3.1.1 Usability questionnaire

Due to the small number of participants we did not perform statistical analyses on quantitative data. The usability questionnaire rating frequencies are shown in Table 1. Higher ratings indicate better usability. The average rating across participants is shown in the rightmost column. The three most highly rated metrics “Terminology related to task” and “Performing tasks is straightforward” were rated towards “always”, on an never/always scale, with an average of 7.7 and “Correcting your mistakes” was considered fairly “easy”, on an difficult/easy scale, with an average rating of 7.6. The most poorly rated metric was participant’s overall reaction to the software’s flexibility with an average rating of 5.7 nearly halfway between “rigid” and “flexible.” Also poorly rated were the software’s ability to inspire excitement (average rating of 6 on a scale between dull and stimulating) and its ability to inform users of its progress (average rating of 6 on a scale between never and always).

Table 1: Usability questionnaire rating frequencies. The three most positive aspects are highlighted in green and the three most negative aspects are highlighted in orange.

Overall Reaction to the software		0	1	2	3	4	5	6	7	8	9		NA	Average
1	terrible						1	2	4			wonderful		6.4
2	difficult						2	2	3			easy		6.1
3	frustrating						1	3	3			satisfying		6.3
4	inadequate power					1	1	2	1	2		adequate power		6.3
5	dull					1	2	2	1		1	stimulating		6
6	rigid		1			1	2	3				flexible		5.7
Screen														
7 Reading characters on the screen	hard					1		1	4		1	easy		6.7
8 Highlighting simplifies task	not at all						1	3	1	1		very much	1	6.3
9 Organization of information	confusing							1	4	1		very clear	1	7
10 Sequence of screens	confusing							1	4	1		very clear	1	7
Terminology and system information														
11 Use of terms throughout system	inconsistent						1	3	2			consistent	1	7.2
12 Terminology related to task	never							3	2	1		always	1	7.7
13 Position of messages on screen	inconsistent						2	1	2			consistent	2	7
14 Prompts for input	confusing						1	2	1	1		clear	2	6.4
15 Computer informs about its progress	never					1	2	1				always	3	6
16 Error messages	unhelpful					2		1	1			helpful	3	6.3
Learning														
17 Learning to operate the system	difficult						1	1	2	2	1	easy		7.1
18 Exploring new features by trial and error	difficult						1		3	2	1	easy		7.3
19 Remembering names and use of commands	difficult							2	1	2	1	easy	1	7.3
20 Performing tasks is straightforward	never							3	3	1		always		7.7
21 Help messages on the screen	unhelpful					1		2				helpful	4	6.3
22 Supplemental reference materials	confusing							4				clear	3	7
System Capabilities														
23 System Speed	too slow				1			3	2	1		fast enough		7.1
24 System reliability	unreliable			1	1			4	1			reliable		6.1
25 System tends to be	noisy						2	2	1	1		quiet	1	7.2
26 Correcting your mistakes	difficult							5	2			easy		7.6
27 Designed for all levels of users	never				1		1	3		2		always		7

Overall the results from the questionnaire were positive. Average ratings for all items were greater than five, indicating participants tended towards positive feedback. Participants may have considered the software somewhat inflexible due to the inability to resize the video window. Also the trial tasks were fairly structured, that is, we wanted participants to watch specific videos for each task. Participants were free to explore the Interactive EFIT interface/map for each task, but there were specific videos we wanted participants to watch. If they navigated too far away from the video we wanted them to watch we guided them to the area containing the videos we wanted them to watch. Participants who had their exploration cut short may have felt it was the software that was inflexible.

The average rating of 6 on the dull/stimulating scale needs to be considered. As EFIT is a training tool it is important that students find it stimulating otherwise they will tune out. Participants were excited to see video of areas that they had travelled on a previous deployment, yet uninterested in watching video that was outdated. It is also possible that the video training lessons were second nature for participants who had attended MAT or ETHAR over 68 times in their careers. See Section 3.2.1 for a discussion of what participants felt they learned from Interactive EFIT.

The relatively low rating of the software's ability to inform users of its progress is difficult to explain. Participants may not have had a clear understanding of what progress meant in this context. The software does not have many sequential processes where user input is required. Consequently, three participants considered the question "not applicable." The software does have a progress bar below the video to show how far along the video has elapsed. The map also has an indicator for the position of the video on the map. When a video is played, the track on the map turns yellow as the video moves forward in space. We neglected to describe the map progress bar in the instructions prepared for participants. If participants did not look at the yellow map bar when the video was playing they would not have been able to interpret what the blue and yellow meant when the video was not playing. Further instructions describing the progress bar on the map are required. Interactive EFIT might also benefit from a better interface integration of the progress bar under the video and the progress bar on the map. If the progress bar on the map is designed properly then the progress bar under the video becomes redundant.

Participants may also have interpreted the rating "Computer informs about its progress" to mean that the software would inform the user of their progress using it. Since Interactive EFIT is a training tool participants may have expected that the software would provide them with feedback as to how well they progressing through the trainer. They may have expected feedback such as "you have reviewed 10 of the 50 videos" or "you have read five of the 10 IED reports for this route."

When listing the three most negative aspects of the prototype four of the seven participants recommended a larger screen. The preference for a larger screen may originate with participant's experiences viewing video and maps on large wall mounted displays. Paper maps also offer a larger display than the 18 inch screen that was used for the trial. Participants may also have been expressing a frustration that the video window could not be enlarged.

The second most reported negative aspect of the prototype listed by participants (two of seven) was the audio. This can be elaborated by noting that the expert commentary for the KAF to Kandahar City video was very low volume, participants did not like the fact that the crew Comms for the MSG to PBSG video were simulated, the Comms for the MSG to PBSG video were

difficult to hear over the vehicle engine noise and the trial room was very noisy from what might have been an heating, ventilation, and air conditioning (HVAC) system component.

Participants also suggested adding route names, better video quality, night and evening videos, videos from different positions in the vehicle and panoramic videos.

For the three most positive aspects of the software, four participants most appreciated the video footage and the training potential of the Interactive EFIT prototype. Three out of seven participants listed the easy to use and navigable interface and two participants listed the map.

3.1.2 Participant comments and our observations

Overall participants found the Interactive EFIT prototype easy to use. When commenting on the usability of the interface it was often the interactive nature that participants appreciated. Participants appreciated being able to move the video and map windows around and position them as desired, the ability to pause the video at “key features” to write notes, the “user friendly system for pulling up info from previous IEDs and locations” and having the map and video synchronized.

We observed that all participants had difficulty switching between the various EFIT tools. Most participants tried to open up the IED incident reports using something other than the hyperlink tool. Ideally users should be able to click on IEDs using the selection arrow (that is used to play video from the map). Unfortunately at the time of the trial, using the ArcMap hyperlink tool was the only option to bring up the incident reports. Users should also be able to pan the map with the selection arrow, avoiding having to switch to the pan hand tool. An onscreen zoom bar (such as Google MapsTM) would also eliminate the need to switch to the zoom in and zoom out tools. Ideally all interaction with the interface could be done with one tool, the selection arrow.

Participants’ interactions with the map highlighted a few design deficiencies:

1. The direction of the route video was not clear on the KAF to Kandahar City and MSG to PBSG videos. The yellow progression indicator at the start point of the video (see Figure 9) was not intuitive. When the video was not playing it was ambiguous whether the blue or yellow indicated the forward direction of travel. Symbols (triangles) like the ones used for the Kandahar City routes (see Figure 4) should be used to indicate the video direction on all route video tracks or video start points should be distinctly marked from the end points (this option is less helpful when the start and end point are outside of the current map view). The direction indicators should have consistent size, shape and colour (those used in the prototype were added to demonstrate possible options). Participants also wanted a better indication of where the video was being shot from on the map. Participants were unclear whether the end of the yellow line indicated the position of the front of the vehicle or the location of the camera mounted on the vehicle. Again a symbol of some sort (possibly a video camera) would be useful here. An optional overlay showing the camera’s field of view may also be helpful.
2. As participants interacted with the map as the video played, they would lose sight of the location of the current position of the video camera. Participants would sometimes be zoomed too far into the map and the yellow indicator would traverse off the map or they would want to investigate something to either side of the video track and loose the camera position. For

novice users it might be useful to have the map always centred on the location of the video camera. For more comfortable users this option could be disabled allowing them to freely navigate around the map. A “zoom to video camera position” button, like the “snap” to your current GPS location feature available on many mobile positioning/mapping apps (e.g., Google Maps), would allow advanced users to quickly reposition the map on the video camera. Additionally, an indicator in the margin of the map window indicating the direction of the current location, like an arrow or even a coloured marker that forms a line between the centre of the current map view and the camera location, could help maintain awareness of the position of the inspected area relative to the video view, which might make some people more comfortable.

3. It could be disorienting for participants when switching from one route video to another using the options panel. The map discretely jumped from one location to another. This disorientation could be prevented with a smooth transition that zooms out from the initial location, transverses the map, and zooms into the location of the selected video. This technique offers “visual momentum” (Woods, 1984). Labelling tactical features such as forward operating bases would also improve situation awareness (Endsley, 1995).
4. Map symbols representing IED incidents should not be the same colour as the route video tracks as they may appear to be part of the track.

The layout of the video alongside the map as shown in Figure 3 may not be optimal. Two participants ignored the map entirely while the video was playing. Another participant maximized the map and placed the video window where it would not obscure the route track (Figure 9). Participants who considered the software inflexible may have appreciated instructions in the EFIT 101 tutorial on how to resize the map and move the windows around. Participants who found the software inflexible may also have been expressing frustration that the video window could not be resized.

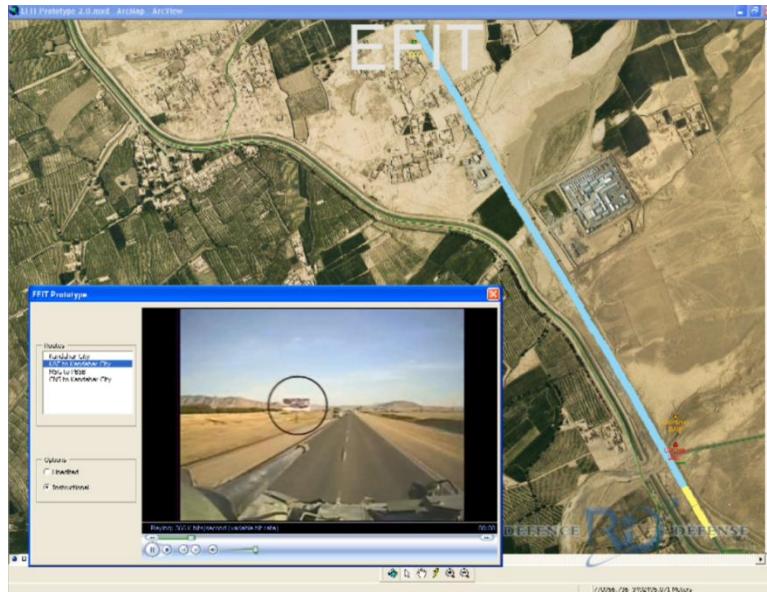


Figure 9: Example of the map maximized behind the video window. Note the yellow progress bar in the bottom right corner. As the video track is played, the yellow progress indicator extends along the blue route to indicate the location where the video was recorded.

Some participants expected more context for the Interactive EFIT videos. Participants wanted details on the purpose of the convoys and who and what vehicles were in them. Sometimes participants were surprised by the way the vehicle crews reacted to certain situations, but felt had they had more information about the convoy they might be able to understand why the crew acted as they did. Participants would have preferred more recent video footage (< 6 months old) as insurgent and CAF tactics change frequently.

More details would be required on the routes listed in the Options Panel if the number of routes within Interactive EFIT were to grow. Details such as: start location, end location, route name(s), date of video recording will help users select an appropriate video. A keyword search feature may also facilitate efficient video selection.

Other observations of note: Four participants ignored the options panel and had to be prompted to use it, two participants did not use or recognize map IED data, two participants used the speaker volume knob to increase the volume of the video, ignoring the software's volume slider and one participant often pointed and touched the screen to indicate locations. One participant used the map to perform a thorough route recce before watching the video and another thought selecting an IED incident and playing the video would give a playback of the IED strike.

3.1.3 Feature use

Table 2 contains a summary of feature use. For each task the number of participants who used the feature is indicated. The average is listed in the rightmost column. Nearly all participants used the list box to switch between videos and the video play button in each task. Playing a video from the list box required users to click the video play button in addition to selecting the video. The number of participants using the list box to play videos drew to our attention that having users

select a video is sufficient to start playing the video. Future prototypes should play videos automatically from the beginning when users select a video from the list box.

Table 2: Frequency of participants' Interactive EFIT feature use by task.

Feature	Task 1	Task 2	Task 3	Task 4	Average
Pan	6	2	4	7	68%
Zoom	6	0	3	6	54%
Click on IED	2	2	2	5	39%
Change audio options (radio buttons)	0	4	4	4	43%
Switch route (list box)	6	6	5	7	86%
Seek on video	0	2	3	5	36%
Seek on map	0	0	1	2	11%
Stop (button)	1	1	4	4	36%
Play video (button)	6	5	7	7	89%
Change volume	2	4	5	6	61%

Participants did not switch between audio options for the first task, but Tasks 2 through 4 were designed with the expectation that participants would explore this option. One participant commented that “watching the video first with live Comms and then again with dubbed SME commentary (is) very beneficial.”

Only three of the participants clicked on the map to seek through a video. As described in Section 3.1.1 this might be due to the fact that the yellow progress bar was not described when the Interactive EFIT features were introduced. However, the instructions provided did describe clicking on the route video tracks to play a video. Since this feature was not used until Task 3, it is likely that participants were unsure how this feature worked. We need to revisit the intuitiveness of this feature and how to best train users to associate the progress of the video with progress on the map (e.g., maybe a task where they have to view video segments specific to a geographic location).

We also asked participants how many times they would want to watch the video in Task 1 before they felt confident with the route. Participants expected they would view the video two to twelve times. Participants felt they would watch the video a few times with pauses and a few times watching it uninterrupted.

3.1.4 Software bugs

As participants used the Interactive EFIT prototype we noticed a few software bugs that were not observed during preparation:

1. The map data disappeared sporadically after participants panned and zoomed.
2. Since the EFIT arrow is the ArcMap select features tool, it allowed participants to click and drag on the map to select multiple segments of a video route track. Participants who clicked and dragged over a video track for one reason or another were not expecting to be able to select segments of the track (the track appears continuous). Once the track segments were

selected, participants did not know how to unselect them and resume their previous activity. Video track route segments should not be selectable.

3. Similarly to bug #2, when participants clicked on features other than the video track using the EFIT arrow, the features would highlight. The software did not tell participants what the highlight meant and did not provide them with additional actions when highlighted. Map features should not highlight when clicked in future prototypes unless users can interact with them in some way.
4. The IED database received from the CAF Mapping and Charting Establishment appears to have some errors in the location of incidents. Some IEDs are placed in inexplicable locations. Errors may be due to the precision of the grid reference used when reporting.
5. We noticed that when a playing video reached the end and stopped the map would refresh many times. On occasion the map entered a cycle where it infinitely refreshes, crashing the software.
6. Occasionally the yellow progress indicator for the video routes on the map did not update correctly to show the correct position of the video camera.
7. Clicking on IED incidents with the lightning bolt hyperlink tool to open incident reports requires a high degree of placement precision. A wider margin of error for cursor placement should be implemented in future prototypes.

These bugs need to be resolved before further user testing. We recommend that tooltip hover boxes be added to the EFIT tools. Tooltips provide information in a hover box when users hover the mouse pointer over an item without clicking it. Tooltips can also be used with Interactive EFIT to show more information when users hover over video tracks and IED incident data.

3.2 EFIT's training potential

3.2.1 Usefulness questionnaire

The seven participants were asked to rate the usefulness of Interactive EFIT for seven learning objectives. Average results for the participants in this study are shown in Table 3 alongside the 32 students and 11 instructors from 2CER TMST TF 3-08 ETHAR and the 49 students from TF 3-09 1CER training lectures who watched the two non-interactive video prototypes described in Section 1.2. The top three ratings for each group are highlighted in green. The TF 3-08, TF 3-09 and Interactive EFIT data is contrasted here to get a sense of the relative strengths and weaknesses of the different prototypes.

Table 3: Average usefulness ratings of EFIT for learning specific skills. The top three scores for each group are highlighted in green.

Usefulness of EFIT for learning the following (1 = not at all useful; 5 = extremely useful)	TF 3-08 Non-Interactive EFIT students (n=32)	TF 3-08 Non-Interactive EFIT instructors (n=11)	TF 3-09 Non-Interactive EFIT students (n=49)	Interactive EFIT (n=7)
1) Route familiarization	3.4	3.6	3.6	4.7
2) Theatre-specific terrain familiarization	4.4	4.3	3.9	4.6
3) Theatre-specific cultural environment familiarization (“what is normal”)	4.1	3.9	4.0	3.4
4) Detection of IED indicators	4.3	4.3	4.1	4.3
5) Assessment of IED threat	4.0	4.1	4.0	4.0
6) Introducing context of convoy experience	3.8	4.0	3.8	3.4
7) Training for scanning an arc	3.2	3.6	3.5	2.6
Average	3.9	4.0	3.8	3.9

We note here that a statistical comparison of the usefulness ratings, both within each user group, and between the groups, is problematic for a number of reasons. The number of participants in each group is very uneven (32, 11, 49 and 7 for the TF3-08 students, TF3-08 instructors, TF3-09 members and the PSTC participants, respectively), thus making it very unlikely that the combined data set would meet the variance assumptions required for inferential statistics. Perhaps more importantly, as these data were not collected under a systematic experimental design, many uncontrolled factors varied between each group, in addition to the EFIT design itself, making between-group differences very difficult to interpret. Furthermore, the different utility ratings are not systematically related to each other, and merely represent users’ subjective impressions regarding the utility of different features of EFIT preferences. Thus, it is again difficult to interpret a significant difference between the ratings of different EFIT features. Nevertheless, there is some value in knowing whether the response patterns of the different groups actually differed. For this reason, the ratings presented in Table 3 were subjected to a mixed design, between-within analysis of variance, with group (TF3-08, TF3-09 and PSTC) as the between-subjects factor, and the 7 usefulness ratings as the within-subjects factor, with a significance level of $\alpha = .05$. (The two subgroups of TF3-08 were pooled together, as a preliminary analysis showed no statistical differences between these two subgroups). The analysis revealed a main effect of ratings ($F(6,558) = 13.1$, $MSE = 0.54$) and an interaction between group and ratings ($F(12,558) = 3.8$, $MSE = 0.54$). This suggests that the different groups rated the 7 EFIT features they were asked about differently, and that the pattern of preferences varied between groups. However, for the reasons given above, no further analyses were performed, and participants’ ratings are discussed hereafter without reference to their statistical significance.

Participants using Interactive EFIT found it most useful for route familiarization. The interactive prototype scored higher than the non-interactive videos for route familiarization. As noted above, the reason for this preference is difficult to ascertain. We feel that that panning and zooming on

the map likely improved perceptions of Interactive EFIT's usefulness for route familiarization. However, the difference in preferences could also be due to other differences between groups, for instance, different operational experiences, or even simply the fact that so few participants used Interactive EFIT relative to the non-interactive version. Determining the cause of these differences is beyond the scope of this study and would require further work.

Second to route familiarization, participants felt the interactive prototype was also useful for theatre-specific terrain familiarization. This high rating is consistent with the non-interactive videos. Also consistent with the non-interactive videos was the perceived usefulness of Interactive EFIT to teach the detection of IED combat indicators. The ratings show EFIT has good potential as a training tool and warrants further study. Participants felt the Interactive EFIT prototype was least useful for training arc scanning.

Participants were also asked to rate the usefulness of adding features to EFIT. Results for the seven PSTC SMEs who used Interactive EFIT are shown in Table 4 alongside the 32 students and 11 instructors from 2CER TMST TF 3-08 ETHAR and the 49 students from TF 3-09 1CER training lectures who watched the two non-interactive video prototypes described in Section 1.2. The top three ratings for each group are highlighted in green. Participants were not asked to rate features rated N/A. For the most part these features had already been implemented in the Interactive EFIT prototype. (As noted above, no statistical analysis of the responses was performed here, as statistical differences between ratings for hypothetical EFIT features are even more difficult to interpret than between ratings for actual features).

Table 4: Average usefulness ratings for EFIT additions and improvements. The top three scores for each group are highlighted in green.

Additions and Improvements to EFIT (1 = not at all useful; 5 = extremely useful)	TF 3-08 Non-interactive EFIT students (n=32)	TF 3-08 Non-interactive EFIT instructors (n=11)	TF 3-09 Non-interactive EFIT students (n=49)	Interactive EFIT (n=7)
1) Incorporate videos of the same route taken at different times of day	4.1	4.4	3.9	4.1
2) Improve visibility of indicator cues	3.6	3.9	3.4	N/A
3) Add image intensified (II) video	3.3	3.8	3.5	4.5
4) Add infrared (IR) video	3.3	3.5	3.5	4.6
5) Add locations of past IED incidents on route map	4.3	4.1	4.2	N/A
6) Add details of past IED incidents on route map	4.0	3.2	4.1	4.6
7) Add locations of OPFOR activity on route map	3.7	3.1	3.9	4.6
8) Highlight locations of canalizing ground on route map	3.3	3.6	3.7	4.0
9) Remove map	3.2	2.5	2.2	1.0
10) Add locations of pogo-points / waypoints / checkpoints / destinations on route map	3.0	3.5	3.0	3.9

Additions and Improvements to EFIT (1 = not at all useful; 5 = extremely useful)	TF 3-08 Non-interactive EFIT students (n=32)	TF 3-08 Non-interactive EFIT instructors (n=11)	TF 3-09 Non-interactive EFIT students (n=49)	Interactive EFIT (n=7)
11) Add the option to switch between a map mode vs. the satellite imagery	3.2	2.8	3.0	3.3
12) Add zoom functionality to the map	3.6	2.8	3.2	N/A
13) Show alternate routes to destinations on route map	3.8	3.3	3.5	3.6
14) Indicate the date and time of day the video was taken	3.3	2.2	3.0	3.9
15) Add the name of the route the video was taken	3.1	2.2	2.8	4.3
16) Make the map interactive so that routes can be clicked on to play video sequence	3.8	3.6	3.4	4.3
17) Add simulation demonstrations of TTPs	4.0	4.4	3.7	N/A
18) Increase size/length of video	4.0	3.6	3.4	3.6
19) Different camera views (2nd vehicle in OOM, rear view, gun turret view)	4.3	4.3	3.9	4.4

Participants who used Interactive EFIT felt the most useful additions were adding image intensified video, details of past IED incidents on the route map, and adding locations of opposing force (OPFOR) activity on route map. Having interacted with the map for the four testing tasks, users of Interactive EFIT saw no usefulness in removing the map. Participants using Interactive EFIT also rated highly adding infrared video and different camera views (e.g., 2nd vehicle in OOM, rear view, gun turret view).

In addition to the features listed in the questionnaire results (Table 4) above, the seven PSTC participants suggested additional features that they would like to see in future prototypes. Participants wanted more information on the buildings alongside the route. They requested building heights and strategic importance, if any. Participants wanted video with a larger field of view and videos from the various vehicle platforms (Leopard 2, Light Armoured Vehicle III, Tracked Light Armoured Vehicle, etc.). One participant suggested that the instructional SME video should pause occasionally throughout playback to highlight and describe important features.

Participants also wanted to be able to mark-up the map with possible IED locations and terrain features. Participants envisioned a tool with these features would be useful in theatre prior to departing on a mission outside of the wire: “(I would) look at (the) system the night before to plan and get a sense of what’s there.”

When asked if they learned anything new while using Interactive EFIT that was not included in previous training, two participants did not answer the question, one participant said “no” and the other four participants wrote:

1. “This provided excellent famil(iarization) with terrain, pattern of life and road conditions. Great acclimatization.”
2. The “actual view of roads I would use. With time (I) could clearly identify possible IED areas and choke points. (Interactive EFIT) could definitely help plan for convoy ops in the future.”
3. “Video of ground, reactions of vehicles, reactions of people. Actual possible IED encounter that can't be portrayed in pictures.”
4. “This would be a ‘first’ for seeing footage of the ground before being in theatre for the first time.”

All participants indicated Interactive EFIT has potential training benefits. Participants felt Interactive EFIT could be used for the following teaching points:

1. “With more videos of different times you can learn local traffic patterns thus allowing you to plan better convoys.”
2. “Something that is impossible to replicate is seeing Kandahar for yourself, (Interactive EFIT) allows (students) to do that. Any of the crowded villages also, you wouldn’t believe the crazy things happening there, but to see it beforehand (is useful).”
3. You can “realize the terrain you will be in – cars all over the road, choke points, etc. (They) are a concern but there’s nothing really you can do about it.”
4. You can recognise “built up areas (on map) which are possible ambush locations...culverts... routes into and out of the route we are travelling, which could be used as VBIED routes.”
5. “Firsthand view of interaction between convoy and locals.”
6. Learn routes before entering theatre and review routes for changes since last tour.
7. Communications.

3.2.2 Verbal comments on EFIT uses

Prior to the trial we anticipated Interactive EFIT would be used by ETHAR trainers for briefing IED threats during TMST. We thought the main benefit over traditional training technologies would be the visualization of IED threats within the environment in which they are likely to occur. We also anticipated that troops could benefit from using Interactive EFIT on their own to explore the route within their AO and become familiar with local threats. Trial participants also identified these uses and offered other ways Interactive EFIT could add value to the CAF:

1. Many participants suggested Interactive EFIT could be watched in vehicle crew groups. Crews would be instructed to “critic [sic] flaws and point out things done well, practice Comms, call out threats and reactions to indicators.” Participants felt crew members would learn from each other, “bring(ing) up points that others will have missed.” An SME or instructor could provide feedback on how the group did.
2. Before navigating a route, crew commanders could be brought together to watch Interactive EFIT videos together. Crew commanders would “discuss how the route will be navigated: ‘when we get here we will slow down, here we will speed up if we can, (and) obviously terrain and traffic will still dictate’. Crew commanders could also discuss “past IED sites and how the area will be dealt with.”
3. Integrate Interactive EFIT into Rules of Engagement training.
4. Individual learning and training (i.e., “Language Lab”).
5. Gunners and crew commanders could use Interactive EFIT together to practice communications (threat identification).
6. Drivers could use Interactive EFIT to simulate route drives. We expect 360 degree video and a physical/motor component may be required.
7. Route familiarization with paper map that will be used in theatre: “Watch the video, track progress on computer map, locate current, start and end positions on paper map, then phase out the computer map so they can track progress and find their location using the paper map (since they won’t have the computer map in the vehicle with them but they could easily have a paper map in the vehicle).”

3.3 Trial procedure observations

As documented above, this Interactive EFIT user trial provided useful feedback for future iterations of development. We recommend that as new prototypes are developed further user testing is conducted. This section outlines a few lessons learned from the conduct of the trial that we would consider doing differently in future trials.

As noted in Section 3.1.1 we did not provide participants with instructions on how the colour of the video track changes (from blue to yellow) when playing a video to indicate the position of the video camera. Our misstep not documenting this feature provided additional unexpected feedback on the interface feature. The think aloud technique provided us with feedback on what participants thought the change in colour meant, thus providing a measure for the intuitiveness of the interface feature. In future studies where measures of the intuitiveness of an interface are sought we recommend intentionally not documenting features and asking participants to explain the function of the interface feature.

There were a few interactions with the interface that we did not record. During the four tasks participants moved the video and map windows much more than we had expected. Future studies should record the number of times windows are relocated, resized and their positions on the desktop. Feedback on user preferences for windows locations and size can be used to organize the

windows in an optimal arrangement when users first begin using the software. If different arrangements are preferred for different tasks, we could facilitate the rearrangement of windows through interface design techniques, such as an interface that learns the user's preferences and adapts appropriately for the task.

We also did not record the use of window scroll bars or clicks on features that we explicitly asked participants not to use. Three participants used their mouse cursor to scan the terrain of the playing video. It would have been useful to quantify this behaviour. We had intended to use Morae (TechSmith, Okemos, Michigan) software to record user interactions with the prototype, but due to time constraints we were not able to. We recommend using a tool like Morae which records detailed user interactions with computer applications for future studies.

As mentioned in Section 3.1.1 noise from an HVAC system made it difficult for participants to hear the audio tracks of the Interactive EFIT videos. The HVAC noise also reduced the audio quality of the session video recordings. Some participant statements on the video were not intelligible. We recommend insisting on a quiet room when making arrangements for on-site user testing.

When deploying questionnaires in future user testing, we should discuss responses with the participants. Discussing high and low ratings will reduce post hoc interpretations of why participants rated items the way they did. Future trials with quantitative performance measures (speed, accuracy on completion of specific task goals, correctness of procedures followed, etc.) and quantitative evaluations of training effectiveness would also be helpful to validate (or not) participant opinions.

4 Conclusions

Overall participants found Interactive EFIT to be an easy to use and felt it has potential as a training tool for the detection of IED combat indicators and theatre-specific route and terrain familiarization.

That said, feedback from the usability questionnaire suggests the software needs to be made more flexible. Allowing users to resize the video window would be a great first step to improve flexibility. Participants also did not find Interactive EFIT overly stimulating.

We need to reconsider the intuitiveness of the yellow video progress bar on the map, vehicle crew Comms should not be simulated where actual Comms do not exist and the number of tools required to interact with the map should be reduced.

We need to fix documented software bugs. Most urgently we need to address bugs that prevent the map from updating correctly or cause the software to crash.

Participants identified image intensified video, details of past IED incidents on the route map, and adding locations of OPFOR activity on the map as priorities for new features to be implemented.

Despite the changes that need to be made participants found Interactive EFIT suitable to teach: local traffic patterns, village behaviour, ambush locations, culverts, alternate routes, possible IED areas, and communications. They also thought Interactive EFIT would be useful for: crew discussion sessions, in-theatre crew commander planning meetings, rules of engagement training, individual terrain familiarization, communication of threat identification, and driving simulations.

Comments from participants highlight multiple (possibly competing) uses for Interactive EFIT as a Counter-IED training tool and an intelligence tool (either for training or planning).

We recommend implementing the feedback from this evaluation into future Interactive EFIT prototypes. Further user evaluations should also be conducted with a usability testing tool such as Morae (TechSmith, Okemos, Michigan).

A separate study was conducted to evaluate the training effectiveness of EFIT video content (not of the Interactive EFIT features evaluated here). That study found that EFIT can be effective in improving soldiers' IED threat judgements (Jarmasz et al., 2010). Together the usability study reported here and Jarmasz's effectiveness study suggest that EFIT can be a training tool with good effectiveness and usability, and highlight improvements that could make it more so.

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Annex A Early EFIT prototypes



Figure A.1: Screenshot of the first EFIT prototype with ground vehicle video of Afghanistan beside aerial imagery showing the moving position of the camera (yellow line).



Figure A.2: Screenshot of the second EFIT prototype.



Figure A.3: Paper prototype of an interactive version of EFIT.

Annex B Video commentary

B.1 KAF to Kandahar City

Filmed in Kandahar May 2007.

VIDEO COMMENTARY

You can see a large advertising sign off to the left which would make a very good aiming marker. The jingle truck ahead pulls off the road but remains close to the convoy and could hide a large amount of explosives. There is no civilian infrastructure or people in the area which could also indicate an attack. However the ground is wide open to the right.

There are a number of culverts on this road that could conceal IEDs. The trees or telephone poles on the right are potential aiming markers and the buildings to the left provide observation positions and could conceal firing points. However, the ground here again is wide open.

Coming up on the right are a number of fuel trucks very close to the edge of the road. There is also a lack of local personnel in the area. However with a detonation here there would be a lot of collateral damage to the infrastructure.

The truck seems to have the convoy canalized between him and the large pile of rock on the left, either of which could have an IED concealed in them.

Here the IED could be in the culvert under the road with the end of the wall acting as an aiming marker.

Table B.1: SME notes used for video commentary (KAF to Kandahar City).

Time	Cue	Positive IED Indicator(s)	Negative IED Indicator(s)
0:08	Advertising sign and large truck on the left	The sign is a possible aiming marker, truck is very close, could be a SVBIED, no civilian infrastructure or personnel in the area	The ground is wide open so the convoy could veer to the right to avoid the truck
0:08-0:42	Culverts, trees, telephones poles, buildings in general	There are a number of culverts on this road which could conceal IEDs, the trees or building to the left could be concealing a firing point and the telephone poles and trees to the right might be used as aiming markers	The ground is wide open
0:42	Fuel trucks on the right	Trucks are very close to the road, lack of people in the area	There would be a lot of collateral damage to the infrastructure

Time	Cue	Positive IED Indicator(s)	Negative IED Indicator(s)
0:57	Debris on the left, truck on the right	Truck seems to have the convoy canalized between him and the debris/rocks to the left, either of which could have IEDs concealed in them	
1:05	Culvert with built up area on the left	Culvert could hide an IED and the end of the wall could be used as an aiming marker, firing point could be in the built up area to the left	
1:21	White car from the left	White car approaches from the left and crosses the road ahead of the convoy	Clears the road before the convoy passes

B.2 Downtown Kandahar City

Filmed in Kandahar Dec 2005.

VIDEO COMMENTARY

You can see a concrete medium off to the left. It protects the convoy from oncoming traffic or VBIEDs from the left but at the same time it could be used to conceal explosives in the concrete itself, and if there is an ambush or IED attack it will limit the convoy's movement.

You have a parked car in the middle of the road, directly ahead, between it and the concrete medium you have a choke point, therefore the car is a potential VBIED, but the local police seem to be dealing with it and the locals aren't avoiding it.

You see a stone arch to the front; it's fairly narrow, leading to a traffic circle. The arch could conceal a large amount of explosives but may not be a good target depending on the religious or cultural significance of the arch itself. There's a drop down gate so the convoy has to slow down or come to a stop before entering the round-about which in itself can be quite chaotic with all the pedestrians and traffic. This is a good example of a choke point as there is no other by-pass.

You will see a yellow car off to the right, the 2nd one, which veers the convoy to the left. The black truck on the left could be a good spot for an IED with the telephone pole acting as an aiming marker. But the street is very busy with people and the truck is too far off the road to cause significant damage to armoured vehicles if detonated.

Same situation again, the yellow taxi channels the convoy to the left where the black SUV is pointed at the convoy, possibly a suicide VBIED. There are many possible firing points from within the buildings on the right. Depending on your ROEs warning shots may have been required in both those incidents.

We're coming up on a piece of carpet on the road to your right which could camouflage a pressure plate IED. Possibly not much of a threat because so many cars have driven over it and it is a paved road with lots of people about.

Table B.2: SME notes used for video commentary (Downtown Kandahar City).

Time	Cue	Positive IED Indicator(s)	Negative IED Indicator(s)
0:00	Concrete medium on the left (close proximity to convoy)	Could conceal explosives and/or limit convoy's movement in case of an attack/ambush	Protects convoy from oncoming traffic (VBIED) from the left
0:15	Stopped/parked car on road directly in front of convoy	Potential VBIED waiting for convoy to pass in close proximity (choke point)	ANP on site dealing with it, vehicle appears new/good condition, locals not avoiding it
0:50	Large stone arch at end of street leading to traffic circle	Arch could conceal a large amount of explosives, narrow passage with gate which means convoy has to slow down/stop (choke point)	Arch may not be a good target depending on the religious/cultural significance, ANP and many local people around
1:22	Choke point between tuk-tuk/rickshaw/ wagon and yellow car, note the black truck beside telephone pole on left immediately after	Yellow car on right, veers convoy to the left, either the wagon or the black truck on left could be a VBIED, telephone pole by the truck is a possible aiming marker, buildings on the right allow for good overview (possible firing point). <i>(Warning shot required?)</i>	Street is still very active with public, black truck is too far off to the left (off the road) to cause significant damage to convoy if detonated
1:36	Choke point between yellow taxi on right and 2 white minivans on the left, black SUV on left pointed at the convoy	Yellow taxi on right cuts the convoy off, black SUV on the left is directed at the convoy, possible SVBIED, very close proximity <i>(Warning shot required?)</i>	Too many locals/people around
1:54	Carpet on road (right side)	Possible camouflage for pressure plate IED	Lots of traffic driving over it, the road is paved, lots of people around

B.3 MSG to PBSG

Filmed in Kandahar November 2007.

VIDEO COMMENTARY

() – contains descriptive text

Table B.3: Video commentary (MSG to PBSG).

Time	Person Talking	Commands/Comms
0m21s	Crew Comd	Eric, reference 100 meters up there, there's a big gap in the wall on the left hand side, just keep your eyes on it
0m27s	Gunner	Roger, I got it
0m39s	Crew Comd	Oh, here comes buddy on a bike. All c/s 11 be advised lone male passing on the left side of the vehicles now, out.
1m51s	Crew Comd	Matt, let's not drive like we're on the country side, let's pick up the speed a bit.
1m58s	Driver	I'm trying to do the best I can
2m02s	Crew Comd	That's what you're always telling us, let's just go
2m26s	Crew Comd	Alright we're approaching the ANA...correction, ANP compound off to the right hand side there
2m48s	Crew Comd	Alright well the ANA Chicane is coming up there, so let's slow down over here
2m55s		Roger
3m22s	Crew Comd	All c/s 11, this is 11A, approaching another village, out
3m30s	Pl Comd12	1 this is 12, message, over
3m33s	Pl Comd 1	1, send
3m35s	Pl Comd 12	12 roger, conducting a short halt with ANP PERS at grid QQ3012589627. We will be moving shortly back to MSG. We will be there in 20 Mikes, over
3m50s	Pl Comd 1	1, roger.
3m54s	Crew Comd	Heyhey, Matt take a look, there's those kids on the side of the road again, the ones that threw the rocks at us. Wonder if they're gonna throw'em. Yep, there he goes. Alright guys, be aware those kids are throwing rocks at us again.
4m08s	Driver	Want me to swerve at one?
4m09s	Crew Comd	(snickering) No, no, no. I want to try to get out without running over a kid, I don't know if it's possible for sure
5m31s	Crew Comd	All c/s 11 this is 11A, be advised that we're exiting the village and approaching more open terrain, out
6m19s	Crew Comd	Matt, pick a speed dude, slow or fast, I prefer fast but stay with it
6m24s	Driver	You want to stop busting my balls?
6m28s	Crew Comd	If you would maintain a certain speed I'd be a happy guy and I'd leave you alone
6m34s	Driver	Hey Sean, Sgt. Major jacked me up for my sideburns again today
6m38s	Crew Comd	Go figure (laughs), go figure, go figure
6m44s	Crew Comd	Alright listen, I don't know what the problem is today Matt, but let's NOT slow down for the culverts, this is a big 18 tonne armoured vehicle and it can take the culvert, trust me
6m52s	Driver	Listen if you want to drive I'll pull over right here and you could hop in
6m56s	Crew Comd	Yeah like you always say, run away from the situation, you're so soft
7m00s	Driver	I'm tired of your nagging

Time	Person Talking	Commands/Comms
7m01s	Crew Comd	Yeah well I'm here as your mother, remember that
7m13s	Crew Comd	Does that look like 12 up there?
7m16s	Driver	Yeah I think so, yeah
7m21s	Crew Comd	Ah Okay. 11 this is 11A, be advised we're approaching c/s 12
7m28s	Crew Comd	12 this is 11A, be advised our call sign will be passing through your location momentarily, we'll be passing to your left, over
7m35s	Pl Comd 12	12, Roger, we'll watch the flanks as you pass
7m46s	Crew Comd	11A Roger, out
11m26s	Crew Comd	Alright guys, just to let you know, this is a stretch of area that 2 commander was talking about with the 4 IED hits, just be vigilant, it's about a kilometer here until the next ANA checkpoint where we can turn left
11m38s	Driver	Don't worry about it man, I'm wearing my lucky underwear
11m40s	Crew Comd	Let's just find your lucky foot so you can pick up the speed
11m44s	Driver	Enough of the jacking, Jesus!
11m47s	Crew Comd	Would you just...drive...the vehicle
11m50s	Driver	I'm the one who signs for the thing, I'm responsible for it
11m53s	Crew Comd	Who signs for what? Let's not forget who (inaudible)
11m56s	Driver	Yeah but you don't have to do the maintenance now do ya?
11m57s	Crew Comd	No exactly, that's your job, I get paid the big bucks to make sure you do it
12m01s	Crew Comd	Listen Eric, just scan left and right to make sure you don't see anything bad
12m03s	Gunner	Kay
12m06s	Driver	You know, Eric you could back me up sometimes you know. Why am I always the one getting shit on?
12m12s	Crew Comd	The reason why is because Eric does his job and you always complain and he doesn't.
12m15s		(Inaudible banter)
12m23s	Gunner	Yeah Matt, drive the vehicle
12m25s	Driver	Oh yeah, here we go, they've teamed up now
14m16s	Crew Comd	Alright that's that an ANA checkpoint coming up there to the right, we'll be turning after that
14m23s	Driver	I know where we're going
14m27s	Crew Comd	(laughing) yeah that's what you always say, that's why when we drive past the place we're supposed to turn and you're like, "What? Maybe if you told me!"

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Annex C L-681 protocol

C.1 Executive summary

Protocol L681

Evaluation of the usability of the Environmental Familiarization and Indicator Training Tool

Principal investigator: Matthew Lamb (DRDC Toronto)

Co-Investigators: Dr. Jocelyn Keillor (DRDC Toronto), Cpl Philip Mach (DRDC Toronto); Sgt Dorothy Wojtarowicz (DRDC Toronto)

Work breakdown element: 12rr03

Executive summary

Anecdotal evidence indicates that experienced convoy crews develop an intuitive sense of potential Improvised Explosive Device (IED) threats in unfamiliar terrain. Often crews will determine that an IED threat is present even if there does not appear to be obvious indicators of that threat. The Environment Familiarization and Indicator Trainer (EFIT) is a tool that is being developed by DRDC Toronto in an attempt to train this intuitive IED detection capability. EFIT provides cultural familiarization of the operational terrain by exposing troops to real video of convoy operations integrated with current high resolution satellite imagery and vector data. In this study, soldiers will be asked to perform a series of tasks using the EFIT software which will highlight any interface design deficiencies in the software.

Risks and medical coverage

The risks in this study are considered to be minimal. No medical coverage is required for this study.

Benefits of the study

The study will help improve and assist in further developing EFIT for its use by the Canadian Forces. Participants will gain a better understanding of potential IED indicators and become more familiar with the Afghan culture and environment. Ideally, they would also gain an improved ability to detect IEDs and the CF will gain a better understanding what an effective software system for training soldiers in IED indicators may look like.

Related studies: L-560 Amendment 13, L564

C.2 Protocol body

Protocol L681

Evaluation of the usability of the Environmental Familiarization and Indicator Trainer Prototype

Principal Investigator: Mathew Lamb (DRDC Toronto)

Co-Investigators:

- Dr. Jocelyn Keillor (DRDC Toronto)
- Cpl Philip Mach (DRDC Toronto)
- Sgt Dorothy Wojtarowicz (DRDC Toronto)

Run Director: Cpl Philip Mach (DRDC Toronto)

Work breakdown element: 12rr03

ACRONYMS

CF	Canadian Forces
CFB	Canadian Forces Base
C-IED	Counter-IED
DRDC	Defence Research and Development Canada
EFIT	Environmental Familiarization and Indicator Trainer
IED	Improvised Explosive Device
IPT	Individual Pre-Deployment Training
PSTC	Peace Support Training Centre
TPP	Tactics, Techniques and Procedures

BACKGROUND

Improvised Explosive Devices (IEDs) continue to pose a significant threat to the safety of Canadian Forces (CF) personnel currently deployed in combat and peace support missions, especially in Afghanistan. A recent memo from the Chief of Defence Staff states that “[IEDs] remain the single most dangerous weapon employed by insurgents in Afghanistan, accounting for the majority of Canadian combat related casualties” (Chief of Defence Staff, 2008). Thus efforts are ongoing throughout the CF and the Department of National Defence in general to mitigate the IED threat.

Many Counter-IED efforts focus on developing new technologies to detect, avoid, neutralize or protect personnel from IEDs. However despite technological advances, detecting IED still depends very much on the judgment and unaided perceptual skills of soldiers (Zorpette, 2008). Accordingly, the CF Counter-IED Tactics, Techniques and Procedures (TPPs) handbook (Department of National Defence, 2006) directs personnel to monitor their environment for the presence of a number of perceptual cues (“indicators”) that suggest an elevated probability of the presence of IEDs.

The CF are interested in improving soldiers’ ability to be aware and recognize such indicators through new training methods to supplement the traditional PowerPoint, classroom training that soldiers currently receive. The IED Awareness Training project (12rr03) at DRDC Toronto is supporting the CF’s efforts on C-IED training by developing Environment Familiarization and Indicator Trainer (EFIT) software which combines real video of Afghan convoy operations with high resolution satellite imagery and vector data, such as position of roads, bridges, culverts and other terrain features, inside a commercial mapping and data analysis software package called ArcGIS created by ESRI, based in Redlands, California. The CF is currently interested in

embedding this software into pre-deployment training and, in particular, the Individual Pre-deployment Training (IPT) course which is run out of Canadian Forces Base (CFB) Kingston.

Interaction design, a discipline which provide guidelines on how to optimally design software interfaces to suit the environment in which they are to operate, dictates that “identifying usability and user experience goals is essential for making every product successful” (Preece, 2002) and that an understanding of users’ needs should be reflected in the design of the software (Preece, 2002). In order to evaluate whether EFIT reflects an understanding of user needs and, thus, suitable for eventual integration in pre-deployment training, user testing of the software is required.

OBJECTIVES

The primary objective of this study is to determine the how usable EFIT is for soldiers required to learn about the Afghan environment and IED indicators. Since EFIT is still in its developmental stages, these data will allow for EFIT to be designed in a manner which will be catered for use by CF members. The secondary objective of this study is to further evaluate the effectiveness of EFIT as a training tool in order to demonstrate that EFIT does, in fact, facilitate a familiarization to the Afghan environment and to IED indicators.

METHOD

Selection of Participants: Approximately 10 male and female soldiers, meeting the standard personnel requirements for the CF (active duty age range 18 to 60), meeting standard vision and health requirements, who are currently at the Peace Support Training Centre (PSTC) will take part in this study as part of the activities for their pre-deployment training.

Procedure and Design: The approach which will be used for this study is that of usability testing. In this approach, a set of tasks will be provided to participants and data will be gathered while participants carry out the tasks.

10 trials will be carried out, each requiring one participant. At the beginning of each trial, the participant will be provided with a brief description of the EFIT system (Figure C.1) and asked to read the information sheet and sign the consent form (Appendix A, Appendix B) before being given a training task to train participants in the use of the ArcGIS system. Participants will be given 4 tasks to perform using the EFIT system. Each task will be designed to test a particular set of functions in the EFIT, a sample display of which can be seen below. The user will be asked to perform the following tasks:

- The first task will involve finding and watching a short video of a convoy travelling away from the Kandahar Air Field,
- The second task will involve adjusting the options of the video viewed in Task 1 to display more information,
- The third task will ask the user to use the playback features to navigate to a specific point in a second video, and
- The fourth will ask the participant to use the information displayed on the map to navigate to various points in a third video.

The videos are of actual scenery (urban and rural) recorded from a moving vehicle in Afghanistan. These videos depict what it would look like, from the point of someone sitting in a vehicle, to transit through terrain in the environments that CF troops patrol and are required to scan for IEDs in Afghanistan.

While the participants complete these tasks, they will be asked to follow the “think-aloud” protocol. The investigators will be taking written notes, as well as, capturing mouse clicks using Morae, software created by TechSmith based out of Okemos, Michigan, and recording the user completing the task using video cameras.

Upon completing these four tasks, participants will be asked to fill in a web-based usability questionnaire derived from the work of Chin et al. (1988, Appendix C), as well as, a questionnaire prepared for use in this particular study asking users what the desirability of possible additions to the system are (Appendix D).



Figure C.1: Screenshot of EFIT.

DATA ANALYSIS

The data will be used to evaluate and guide further development and design of the EFIT interface in the following ways.

The mouse click data will be used to identify any misleading information presented on the screen, in particular, the data will be examined to identify locations on the screen on which the user clicked which may reveal interface elements that do not meet users’ interaction expectations.

The video data will act as supplement to the written notes which will be taken by the observers. The written notes will capture any observable frustration, confusion or other reactions by participants to the software so that those instances can be later reviewed in the recorded video for further analysis. These data will further highlight any short comings of the EFIT interface. The video will also allow for the verification that the users’ conceptual model of EFIT is similar or identical to our own. A conceptual model is how a system is expected to act and behave (Preece 2002) and to ensure proper design of EFIT it is critical that this aspect can be verified.

Means and standard deviations will be calculated and compared for the results of the questionnaire found in Appendix D to identify desirable functionality and the usefulness of EFIT.

The data collected from both questionnaires will be used as a baseline for comparison in future evaluations of EFIT.

TIME INVOLVEMENT

Participation in this study will require 1.5 to 2 hours per participant.

REMUNERATION

As participants will be taking part in this study as part of their pre-deployment training at the PSTC they will thus be performing their normal duties, and they will not be remunerated for their participation.

MEDICAL RISKS

The risks in this study are the same that CF personnel would encounter during the course of their normal duties, namely those involved in sustained use of computer equipment (low to moderate eye and hand strain) and the stress of a decision making task varying in difficulty from low to moderately high. The videos will not be publicly available, yet may be shown in future presentations or demonstrations. In the event that a video from this trial is shown, the identity of the participant will be protected.

PHYSICIAN COVERAGE

This study is considered to involve minimal risk and will not require a physician to be present. There will be no medical screening.

BENEFITS OF THE STUDY

To participants: They will gain a better understanding of potential IED indicators and become more familiar with the Afghan culture and environment. Ideally, they would also gain an improved ability to detect IEDs.

To the CF: The CF will gain a better understanding what an effective software system for training soldiers in IED indicators may look like.

REFERENCES

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C.3 Information sheet

Protocol L-681

Evaluation of the usability of the Environmental Familiarization and Indicator Training Tool

Principal Investigator: Matthew Lamb (DRDC Toronto)

Co-Investigators: Dr. Jocelyn Keillor (DRDC Toronto), Cpl Philip Mach (DRDC Toronto); Sgt Dorothy Wojtarowicz (DRDC Toronto)

Run Director: Cpl Philip Mach

Experimental protocol

The Canadian Forces (CF) are interested in improving the IED threat assessment training through the use of video captured by convoys in Afghanistan. In particular, CF personnel have expressed interest in embedding the Environmental Familiarization and Indicator Trainer (EFIT) software into pre-deployment training. EFIT is a software system that is currently being developed by researchers at DRDC Toronto for use by the CF.

In this study you will be asked to perform a series of tasks using the EFIT prototype. Each task is designed to test a specific set of functions in the EFIT system and are not meant as a test of the IED knowledge that you possess. You will be asked to engage in “think-aloud.” This is where you say what you are thinking in terms of how you are seeing the system, what you think various icons or pictures on the screen mean, what you think should be done and what you are doing at any given point. This again is to further our knowledge of how you perceive the system and is not an indication of your knowledge and will have no bearing on your performance on the course which you are taking. The purpose of this study is to test how easy EFIT is to use and not your knowledge.

After completing the tasks you will be asked to fill in 2 short questionnaires. The first one will provide us with your thoughts on how easy EFIT is to use and your general impression of the

system. The second questionnaire will ask you to rate the desirability of features that we are considering as possible additions to EFIT. You will be provided with a description of the each of the functions so that you can properly judge their desirability.

Investigators from DRDC Toronto will be present, collecting data while you are performing the tasks and will be recording audio and video for future analysis. Your confidentiality will be protected by the investigators and your personal information will not be associated with any reports, publications or presentations that arise from this study.

C.4 Consent form

Protocol L-681

Evaluation of the usability of the Environmental Familiarization and Indicator Training Tool

Principal Investigator: Matthew Lamb (DRDC Toronto)

Co-Investigators: Dr. Jocelyn Keillor (DRDC Toronto), Cpl Philip Mach (DRDC Toronto); Sgt Dorothy Wojtarowicz (DRDC Toronto)

Run Director: Cpl Philip Mach

I have read the experimental protocol and have had opportunity to ask questions of the investigators. All of my questions have been answered to my satisfaction and I have received a copy of this protocol and consent form. However, I may obtain additional information by contacting Matthew Lamb (matt.lamb@drdc-rddc.gc.ca, 416-635-2000 x3006) or Dr. Jack Landolt, Chair of the DRDC Human Research Ethics Committee (HREC) (416-635-2120, jack.landolt@drdc-rddc.gc.ca).

I have been told that I will be performing a series of tasks using the EFIT system and that the session will last between 1 to 2 hours. Data on my performance will be collected via observation as well as audio and video recordings, and I will be asked to complete 2 questionnaires at the end of the session. I understand that I will be video-taped and that these videos may be used in future presentations and demonstrations and that my identity will be protected if these videos are shown. I will also be asked for information about my background and operational experience with the CF. This is a minimal risk study. Also, I acknowledge that my participation in this study, or indeed any research, may involve risks that are unforeseen by DRDC.

I understand that I am considered to be on duty for disciplinary, administrative, and Pension Act purposes during my participation in this study. I understand that my name will not be identified or attached in any manner to any publication arising from this study. Moreover, should it be required, I agree to allow the experimental data to be reviewed by an internal or external audit committee with the understanding that any summary information resulting from such a review will not identify me personally.

My duty status has no effect on my right to withdraw my participation in the research portion of this exercise, refusing to give consent to interviews or to my data being used by the investigators in this study. If I do withdraw my consent, I will not be allowed to take part in the study and any

data that has been gathered relating to me will be destroyed. I also understand that the investigators may terminate my participation at any time, regardless of my wishes.

I understand that I am not entitled to any financial remuneration for my participation in this study.

Secondary Use of Data:

(Please circle) I Consent/Do Not Consent to the use of this study's experimental data involving me in unidentified form in future related studies provided that review and approval have been given by DRDC HREC. I understand that I will be given a copy of this consent form so that I may contact any of the individuals mentioned in Paragraph 1 above.

Participant's Name _____

Signature _____ Date _____

Address _____ Telephone number _____

Name of Witness _____

Signature _____ Date _____

Commanding Officer's Name _____

Signature _____ Date _____

Principal Investigator's Name _____

Signature _____ Date _____

FOR SUBJECT ENQUIRY IF REQUIRED :

Should I have any questions or concerns regarding this project before, during, or after participation, I understand that I am encouraged to contact Defence R&D Canada – Toronto (DRDC Toronto), P.O. Box 200, 1133 Sheppard Avenue West, Toronto, Ontario M3M 3B9. This contact can be made by surface mail at this address or in person, by phone or e-mail to any of the DRDC Toronto numbers and addresses listed below:

Principal Investigator:

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Chair, DRDC Toronto Human Research Ethics Committee (HREC):

Jack Landolt, (416) 635-2120, Jack.Landolt@drdc-rddc.gc.ca

C.5 Task descriptions

Introduction

Thank you for participating in the user testing for Environment Familiarization and Indicator Trainer (EFIT). This booklet contains the tasks that you will be asked to carry out for this trial. The testing consists of 4 tasks and completion of all 4 will take between 1 to 2 hours. You may take a break at any time during the session or stop the session entirely if necessary.

We would like to emphasize that we are interested in assessing the usability of the application, not your performance on the tasks.

When carrying out the tasks, please speak aloud your thought processes (i.e., your actions, intentions, frustrations).

Do you have any questions before you begin?

When you are ready, please proceed to the next page.

About EFIT

The Environment Familiarization and Indicator Trainer (EFIT) is a tool being developed by Defence Research and Development Canada – Toronto as part of the Counter Improvised Explosive Device Technology Demonstration Program (C-IED TDP). The primary aim of EFIT is to aid in the training of those deploying overseas in learning about Afghanistan terrain and culture and becoming more aware of indications of potential IED strikes. EFIT aims to train soldiers in these things through the display of real video of convoy operations with communications, expert commentary and data on the location and type of past IED strikes.

The Peace Support and Training Centre was given a demonstration of this software and have invited us here to help in the continued development of this software.

Please take a moment to read the EFIT fact sheet.

Do you have any questions before we proceed?

EFIT 101

Please take a moment to familiarize yourself with the EFIT interface (screen). Please do not use the hashed features () .

EFIT Toolbar



Interface Components

Interactive map: The interactive map can be used to view roads, past IED incidents and select route video tracks to watch. Roads are shown on the map using green lines, past IED incidents are shown with diamond symbols and labeled with the type of IED. The route video tracks are shown by thick blue lines. These tracks can be clicked to play video of that track.



Route Video Tracks

IEDs

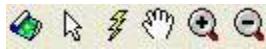
Roads

Route video: The Route Video panel allows users to play, stop, pause and fast forward through the Route Video Tracks.

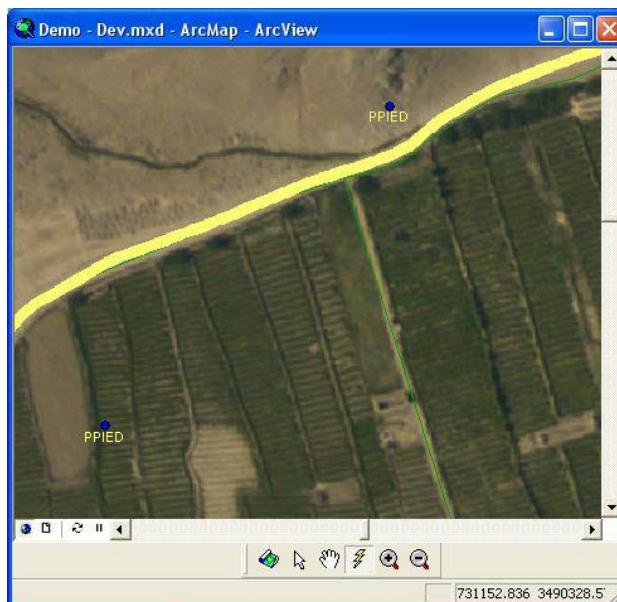
Options panel: The Options Panel has all of the Route Video Tracks that are loaded into EFIT. To play a video click on the name of the route and click the play icon on the Route Video panel. The Options Panel also has options to select whether you want to play a Familiarization Video of the route video or an Indicator Training video. The Familiarization Video is an unedited video

whereas the Indicator Training video has expert commentary about the route and highlighted potential IED indicators.

EFIT toolbar: The tools that you will use to operate EFIT are located on the EFIT toolbar:



- Opens the EFIT program.
- Allows you to select and click on the map. While watching a video, you may click on a part of the track to jump to that location in the video.
- Allows you open incident reports linked to a particular IED strike. Select the tool and if a location turns blue (as shown below) then you may click on it using this tool to open the related incident report.



- Allows you to pan the map. You may also use your middle mouse button. Click on the map with your middle mouse button and hold it down while dragging the map to the desired location before releasing the mouse button.
- Allows you to zoom in on the map. You may also use your middle scroll wheel.
- Allows you to zoom out on the map. You may also use your middle scroll wheel.

Please let the instructor know when you are comfortable with the interface of EFIT and ready to begin the first task.

Task 1

You will be deployed to Afghanistan in several months and have received EFIT as part of your pre-deployment training package. You know that you will be travelling between Kandahar Air Field (KAF) and Kandahar City frequently. To prepare for your tour, take some time to get used to what the route looks like. It is expected that you will be in the gunner position for the majority of your tour.

Task 2

The IED threat in Afghanistan is currently high. To prepare yourself for this high level of threat, learn about potential IED indicators on the route between KAF and Kandahar City.

Task 3

You are about to go on your first convoy mission through Kandahar City and you want to learn more about the types of IED indicators that typically occur in an urban environment. Your crew commander tells you that canalizing from vehicles is something that you will need to prepare for. List below examples of canalization on the route through Kandahar City.

Task 4

You have been tasked to be an air sentry on a convoy travelling between MSG and PBSB and you want to be aware of possible IED threats on that route. Find out what the most common type of IED used on this route was for 2008. List below the key messages from the crew commander in the instructional video.

1. _____

2. _____

3. _____

4. _____

C.6 Usability questionnaire

Questionnaire for User Interface Satisfaction

file:///C:/Documents%20and%20Settings/pmach/Desktop/question.cgi.htm

Questionnaire for User Interface Satisfaction

Based on: Chin, J.P., Diehl, V.A., Norman, K.L. (1988) *Development of an Instrument Measuring User Satisfaction of the Human-Computer Interface*. ACM CHI'88 Proceedings, 213-218. ©1988 ACM. [Abstract] Copying without fee is permitted provided that the copies are not made or distributed for direct commercial advantage, and credit to the source is given. ©1986-1998 University of Maryland. This display is for educational uses only. Commercial use requires a license from the Office of Technology Commercialization: (301) 403-2711 otc@mail.umd.edu [QUIS Home Page] | About question.cgi

Please rate your satisfaction with My HomePage Maker.

- Try to respond to all the items.
- For items that are not applicable, use: NA
- Make sure these fields are filled in: System: Email to:
- Add a comment about an item by clicking on its icon, or add comment fields for all items by clicking on Comment All.
- To mail in your results, click on: Mail Data

System: _____ Email to: _____

Optionally provide comments and your email address in the box.

[Mail Data](#) [Comment All](#) [RETURN TO REFERRING PAGE](#)

OVERALL REACTION TO THE SOFTWARE

	0	1	2	3	4	5	6	7	8	9	NA
1.	terrible	<input type="radio"/>	wonderful <input type="radio"/>								
2.	difficult	<input type="radio"/>	easy <input type="radio"/>								
3.	frustrating	<input type="radio"/>	satisfying <input type="radio"/>								
4.	inadequate	<input type="radio"/>	adequate power <input type="radio"/>								
	power										
5.	dull	<input type="radio"/>	stimulating <input type="radio"/>								
6.	rigid	<input type="radio"/>	flexible <input type="radio"/>								

SCREEN

	0	1	2	3	4	5	6	7	8	9	NA
7. Reading characters on the screen	hard	<input type="radio"/>	easy <input type="radio"/>								
8. Highlighting simplifies task	not at all	<input type="radio"/>	very much <input type="radio"/>								
9. Organization of information	confusing	<input type="radio"/>	very clear <input type="radio"/>								
10. Sequence of screens	confusing	<input type="radio"/>	very clear <input type="radio"/>								

TERMINOLOGY AND SYSTEM INFORMATION

	0	1	2	3	4	5	6	7	8	9	NA
11. Use of terms throughout system	inconsistent	<input type="radio"/>	consistent <input type="radio"/>								
12. Terminology related to task	never	<input type="radio"/>	always <input type="radio"/>								
13. Position of messages on screen	inconsistent	<input type="radio"/>	consistent <input type="radio"/>								

14. Prompts for input

confusing clear

15. Computer informs about its progress	never <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	always <input type="radio"/>	<input type="radio"/>
16. Error messages	unhelpful <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	helpful <input type="radio"/>	<input type="radio"/>
LEARNING	0	1	2	3	4	5	6	7	8	9		NA
17. Learning to operate the system	difficult <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy <input type="radio"/>	<input type="radio"/>
18. Exploring new features by trial and error	difficult <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy <input type="radio"/>	<input type="radio"/>
19. Remembering names and use of commands	difficult <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy <input type="radio"/>	<input type="radio"/>
20. Performing tasks is straightforward	never <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	always <input type="radio"/>	<input type="radio"/>
21. Help messages on the screen	unhelpful <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	helpful <input type="radio"/>	<input type="radio"/>
22. Supplemental reference materials	confusing <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	clear <input type="radio"/>	<input type="radio"/>
SYSTEM CAPABILITIES	0	1	2	3	4	5	6	7	8	9		NA
23. System speed	too slow <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	fast enough <input type="radio"/>	<input type="radio"/>
24. System reliability	unreliable <input type="radio"/>	reliable <input type="radio"/>	<input type="radio"/>									
25. System tends to be	noisy <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	quiet <input type="radio"/>	<input type="radio"/>
26. Correcting your mistakes	difficult <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy <input type="radio"/>	<input type="radio"/>
27. Designed for all levels of users	never <input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	always <input type="radio"/>	<input type="radio"/>
	0	1	2	3	4	5	6	7	8	9		NA

List the most **negative** aspect(s):

1.
2.
3.

List the most **positive** aspect(s):

1.
2.
3.

[Mail Data](#) | [Comment All](#) | [Top of Form](#) | [RETURN TO REFERRING PAGE](#)

C.7 Usefulness questionnaire

Environment Familiarization and Indicator Trainer (EFIT) evaluation

1. Please provide the following demographics. Date: _____

Rank: _____ Trade/Classification: _____ Years in service: _____

Approx number of times you have attended MAT or ETHAR: _____

List your Operational Experience: _____

If deployed to Afghanistan, what was your role? _____

2. Please rate the usefulness of the following proposed additions/improvements to EFIT.
(1 = not at all useful; 5 = extremely useful)

1	2	3	4	5	
					Have videos of the same route taken at different times of day
					Add image intensified (II) video
					Add infrared (IR) video
					Add details of past IED incidents on route map
					Add locations of OPFOR activity on route map
					Highlight locations of canalizing ground on route map
					Remove map
					Add locations of pogo-points/waypoints/checkpoints/destinations on route map
					Add the option to switch between a map mode vs. the satellite imagery
					Show alternate routes to destinations on route map
					Indicate the date and time of day the video was taken
					Add the name of the route the video was taken
					Make the map interactive so that routes can be clicked on to play video sequence
					Increase size/length of video
					Different camera views (2 nd vehicle in OOM, rear view, gun turret view)

3. Please rate the usefulness of EFIT for learning the following.
(1 = not at all useful; 5 = extremely useful)

1	2	3	4	5	
					Becoming familiar with routes
					Becoming familiar with the terrain in theatre
					Becoming familiar with the culture and what's normal in theatre
					Finding IED indicators
					Determining how threatening a situation is
					Becoming familiar with being in a convoy
					Training for scanning an arc

4. Did you learn anything new while observing EFIT that was not included in the training you received? If so, what did you learn?

5. Additional comments.

List of symbols/abbreviations/acronyms/initialisms

ANP	Afghan National Police
AO	Area of Operations
CAF	Canadian Armed Forces
CER	Forces Combat Engineer Regiment
CFB	Canadian Forces Base
Comms	radio communications
DAODs	Defence Administrative Orders and Directives
DRDC	Defence Research and Development Canada
EFIT	Environment Familiarization and Indicator Trainer
ETHAR	Explosive Threat and Hazard Awareness and Recognition
GPS	Global Positioning System
HVAC	Heating, Ventilation, and Air Conditioning
IED	Improvised Explosive Device
KAF	Kandahar Airfield
MAT	Mine Awareness Training
MSG	Ma'Sum Ghar
NA	Not Applicable
OOM	Order of March
OPFOR	Opposing Force
PBSG	Patrol Base Sperwan Ghar
PSTC	Peace Support Training Centre
QUIS	Questionnaire for User Interface Satisfaction
R&D	Research & Development
recce	Reconnaissance
ROE	Rules of Engagement
SME	Subject Matter Expert
SUV	Sport Utility Vehicle
SVBIED	Suicide Vehicle Borne Improvised Explosive Device
TDP	Technology Demonstration Program
TF	Task Force
TMST	Theatre Mission Specific Training

TTPs Tactics, Techniques and Procedures
VBIED Vehicle Borne Improvised Explosive Device

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Defence Research and Development Canada Toronto Research Centre is developing the Environment Familiarization and Indicator Trainer (EFIT) as part of the Improvised Explosive Device (IED) Awareness Training Project of the Counter Improvised Explosive Device Technology Demonstration Program. EFIT is a training tool that provides instruction on IED combat indicators and what to look for in a given area of operation.

A user evaluation was conducted with a prototype of Interactive EFIT software with seven members of the Peace Support Training Centre in Kingston Ontario. The intent of the evaluation was to determine the usability of Interactive EFIT and to gain user feedback on EFIT's training potential.

Participants were briefed on how to use the software and they were asked to perform four tasks using the think-aloud technique. Observations were made as to how participants interacted with the software. Participants also completed a usability questionnaire, rated the usefulness of Interactive EFIT for seven learning objectives and rated the usefulness of proposed features.

Overall, participants evaluated the Interactive EFIT positively and found it to have potential as a training tool. Improvements should be made to Interactive EFIT to make the software more flexible, stimulating and intuitive.

Le Centre de recherche de Recherche et développement pour la défense Canada – Toronto travaille à la mise au point d'un simulateur d'indices et de familiarisation avec l'environnement (EFIT) dans le cadre du projet de sensibilisation aux dispositifs explosifs de circonstance (IED) du Programme de démonstration de la technologie pour contrer les dispositifs explosifs de circonstance. L'EFIT est un outil offrant une formation sur les indices de combat avec IED et expliquant ce qu'il faut tenter de repérer dans une zone d'opérations donnée.

Sept membres du Centre de formation pour le soutien de la paix de Kingston (Ontario) ont évalué un prototype du logiciel interactif EFIT. Cette évaluation par des utilisateurs visait à déterminer la convivialité du logiciel et à obtenir des commentaires sur son potentiel comme outil de formation.

Les participants ont été informés sur la façon d'utiliser le logiciel et ont été invités à accomplir quatre tâches au moyen de la technique de réflexion à haute voix. On a ainsi pu observer comment les participants utilisaient le logiciel. Ceux-ci ont également rempli un questionnaire sur la convivialité, évalué l'utilité de l'EFIT interactif relativement à sept objectifs d'apprentissage et évalué l'utilité des fonctionnalités proposées.

Dans l'ensemble, les participants ont fait une évaluation positive du simulateur interactif et estiment qu'il pourrait constituer un bon outil de formation. Des améliorations devraient être apportées pour créer un logiciel plus souple, plus stimulant et plus intuitif.

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EFIT; improvised explosive device; video; GIS; IED; training; usability